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AB - J57168745 A release agent for surfaces of a metal mould used for casting Al alloy, esp. for cast-forging. The water soluble white release agent comprises one or more than two types of aggregates selected from mica, talc and vermiculite, water soluble organic binder such as polyvinyl alcohol, dextrin, molasses (treacle), a casein or vinyl acetate emulsion, white or achromatic solid lubricant such as BN, carbon fluoride or melamine cyanurate, and water. The content of organic binder comprises 0.5-15% the sum of aggregate + solid lubricant The wt. of solid lubricant is 0.9-2.3 times as much as that of aggregate.
- The mould release agent exhibits plasticity and high peeling resistance during the cast-forging process. The appearance of the Al alloy castings is not spoiled, even if the agent coatings are left on the surfaces.
IW - MOULD RELEASE AGENT ALUMINIUM ALLOY CAST COMPRISE AGGREGATE DISPERSE WATER SOLUBLE BIND DEXTRIN SOLID LUBRICATE BORON NITRIDE WATER
IKW - MOULD RELEASE AGENT ALUMINIUM ALLOY CAST COMPRISE AGGREGATE DISPERSE WATER SOLUBLE BIND DEXTRIN SOLID LUBRICATE BORON NITRIDE WATER
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PAW - (HITU) HITACHI FUNMATSU YAKIN KK
TI - Mould release agent for aluminium alloy casting - comprises aggregate dispersed in water soluble binder e.g. dextrin, solid lubricant e.g. boron nitride and water

PATENT ABSTRACTS OF JAPAN

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(54) MOLD RELEASE AGENT FOR METALLIC MOLD FOR CASTING OF AL ALLOY

(57)Abstract:
PURPOSE: To provide mold release agent for metallic molds for casting of Al alloys which has approximately the same mold releasing property as that of conventional products and does not degrade appearance despite sticking on products by contg. an essential material such as mica, a binder consisting of a wate soluble org. material, a white or colorless solid lubricant having lubricity at up to above the decomposition temp. of the binder and water.
CONSTITUTION: A material which is transparent, white or the like, is of flake- like shapes of particles having good filming property and has heat resistance and corrosion resistance to about 700°C molten Al is used as an essential material. Mica, talc, vermiculite, etc. are used for the essential material. A water soluble org. binder (e.g. CMC), the above-mentioned solid lubricant (e.g. BN) having lubricity up to above the decomposition temp. of the binder and water are mixed with said essential material, whereby the intended mold release agent for metallic molds is prepd. In this case, it is necessary to specify, by weight, 0.1W2.3 times solid lubricant basing on the essential material and 0.5W15% binder basing on the sum of the base material and the solid lubricant.

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(54) Title of the Invention: Mould Release Agent for Aluminium Alloy Casting Moulds

Specification

Claims

1 A mould release agent that is water soluble and white, which is applied to moulds for Al alloy casting, said mould release agent characterised in that the primary composition comprises a main ingredient composed of one or more compounds selected from among mica, talc and vermiculite; a binder composed of a water-soluble organic material; a solid lubricant that is white or colourless and has lubricating properties at temperatures that are at least as high as the decomposition temperature of the binder; and water, wherein

the weights thereof comprise the solid lubricant at 0.1-2.3 times the main ingredient, and the binder at 0.5-15% of the sum of the main ingredient and solid lubricant.

2 The mould release agent according to claim 1, where the main component of the solid lubricant is one or more compounds selected from among boron nitride, carbon fluoride and melamine cyanurate.

3 The mould release agent for moulds according to claim 1, wherein the binder comprises an emulsion of polyvinyl alcohol, dextrin, molasses, casein and vinyl succinate.

Detailed description of the invention

The present invention relates to a mould release agent for Al-based alloy mould casting and, in particular, relates to a mould release agent that is applied to moulds for casting, focusing primarily on melt casting where the mould release agent is subjected to extreme conditions.

Recent casting technologies have made significant advances, and melt casting methods that prevent defects such as cavities and loss of product quality, which are defects that are generally accepted in conventional casting products, have been developed and employed primarily for Al alloys. The

method involves injecting molten metal into a steel mould and then moving a plunger or part of the mould in order to compress the molten metal, so that the molten metal is made to flow into and fill the cavities that form during solidification, thereby preventing such cavities from developing. In addition, the product is in close contact with the casting mould at the time of cooling, so that the cooling rate is increased. This dramatically improves the fine-grain structure of the composition in comparison with conventional methods, resulting in improved mechanical characteristics. With mould casting, a mould release agent is applied to the surface of the mould, and direct contact between the melt and the mould is prevented by the presence of the resulting coated film, thereby protecting the mould and allowing for a decrease in friction when the product is removed. This coating film has comparatively few problems in non-compression processes, but with melt casting, which is accompanied by the plastic deformation of the product, rupture and flaking of the coating film readily occur, so the mould release agents used in the past have been limited to those capable of preventing such rupture and flaking. In the past, water-soluble mould release agents produced by using graphite powder as the primary component

and adding a water-soluble binder dissolved in water have been used in order to attain these objectives. However, these mould release agents are black and have a markedly deleterious effect on the external appearance of a product when deposited, so a colourless or white mould release agent is desired.

In the present invention, the black graphite powder used as the primary component of conventional agents is changed to mica or other white powder, and a solid lubricant is added with the objective of resolving deficiencies in lubrication resulting from this change. In addition, paste or other organic material is added as a binder for these materials, and the components are then dissolved and dispersed in water. The resulting mould release agent has the same mould release properties as conventional compositions, and has the advantage of not compromising the external appearance of a product when deposited on the product.

When this mould release agent is applied to a mould that has been preheated at 150-200°C, the water in the solvent is evaporated and dispersed, and the primary component powder and solid lubricant powder form a layered coating film on the inner surface of the mould due to the presence of the binder.

When the melt is then poured therein, the organic binder of the surface layer of the coating film decomposes to assume a gaseous state. In this layer, the solid lubricant powder is interposed between the powdered primary component, and the resulting gaps are filled with the aforementioned gas. In this condition, the primary component powder can shift position comparatively freely, and thus property produces a thermally insulating coating film that has plasticity on a macroscopic scale. As the gas is dispersed out of the layer, the primary component powder tends to become more constrained than in the aforementioned initial condition, but the presence of the solid lubricant reduces the extent of this constraint and allows the layer to retain its plasticity. As has been described previously, the high-temperature product produced by melt casting causes the film to undergo plastic deformation when under compression, but because the coating film has this plasticity, it can deform in conformity with the surface of the product without rupturing. In addition, in the region in which the binder remains undecomposed, the coating film is deposited as a solid on the mould surface without separating from the surface, thus preventing contact between the product and the mould by remaining between them. As time passes after

pouring, the interface between the decomposition and non-decomposition regions of the binder moves gradually from the coating film surface toward greater depths and finally arrives at the mould surface, and the solidified coating film disappears to form a powdered layer. If compression of the melt occurs during the period in which the non-decomposition region of the binder is retained in the coating film, then the coating film will have sufficient plasticity under compression, and after a sufficient period of time has passed, the coating film will assume a powdered state. In addition, due to the lubricating action of the solid lubricant, the product can be readily removed. Moreover, due to the lubricating action of the solid lubricant that has been added, the mould release agent not only has a release action between the mould and product, but also acts as a lubricant between the fixed and movable moulds or, specifically, between plunger moulds, knock pin moulds and other such moulds, and thus can be well utilized.

The primary component used in the material of the present invention can be transparent, white, or a colour that does not excessively compromise aesthetics when deposited on the product. The particles preferably have the form of flakes, which is desirable in terms of film production. It is also

necessary for the substance to have heat resistance and corrosion resistance with respect to aluminium melt at about 700°C. Mica, as well as talc and vermiculite are primary components that are appropriate under these conditions, and may be used alone or in mixtures. The heat resistance of the solid lubricant is preferably about 700°C as stated above, and substances are preferred that do not lose their lubricating properties even at these temperatures. However, although the solid lubricant on the surface of the layer that is separated off by the binder decomposes and thus loses its lubricant properties, the lubricant in the lower region does not lose this performance, allowing the primary component powder to move in this region and substantially maintaining the plasticity of the coating film. Consequently, a required condition for the heat resistance of the solid lubricant is that the lubricant retain its lubricating properties at least at the temperatures at which the adhesive action of the binder is lost. The solid lubricant must be colourless, white or another colour, as described in relation to the primary component. The most preferred substance in light of these considerations is boron nitride (BN), which is stable up to 900°C, and carbon fluoride (CF; decomposition temperature 320-420°C) is second thereto. The organic

substance melamine cyanurate ("MCA"; sublimation temperature: 360°C) may also be used with good effects in addition to these colourless substances. It is necessary for the binder to be water-soluble. In addition, it is necessary for the binder to form a coating film by the deposition of the primary component powder and solid lubricant onto the mould surface that has been preheated to 150-200°C, and it is also necessary for the binder to have decomposed and lost its adhesive strength when the product is removed from the mould, thus converting the coating film to a powdered state. In light of these considerations, appropriate binders include organic adhesives such as paste (e.g., cellulose sodium glycolate; referred to below as "CMC"), polyvinyl alcohol, dextrin, molasses and casein, as well as vinyl succinate and other resin emulsions. Details of the present invention are presented in the following examples of embodiment.

Example of Embodiment 1

Mica powder with a particle size of 2 μm or less was used as the primary raw material in the amount of 10%, boron nitride powder was used as solid lubricant in the amount of 5%, and the two components were added to a solution produced by

dissolving 1% CMC in water, which constituted the remaining amount. The substances were stirred and dispersed, yielding agent **1** of the present invention. In order to investigate the effect of adding the solid lubricant, a comparative agent comprising 15% of the aforementioned mica and 1.5% of CMC, with the remainder being water, was produced by the same method.

Example of Embodiment 2

The mica used in Example of Embodiment 1 was decreased to 7.5%, and the solid lubricant was changed to 7.5% of carbon fluoride. The other parameters were the same as before, and agent **2** of the present invention was produced.

Example of Embodiment 3

Agent **3** of the present invention was produced such that the solid lubricant in Example of Embodiment 2 above was changed to 7.5% of MCA with a particle size of 0.5-5 μm, and the binder was changed to 1.5% of CMC. In addition, a conventional agent was prepared by adding 15% of graphite powder with a particle size of 10 μm or less to water containing CMC dissolved at 1%, and dispersing these substances.

The performance of these mould release agents was evaluated in the manner described below. Specifically, the mould was composed of steel, and comprised an outer mould having an inside diameter of 40 mm, a height of 100 mm and a width of 50 mm, and upper and lower cylindrical rod-shaped moulds with an outside diameter of 39.7 mm. After heating these moulds to 150°C, the mould release agent described above was applied. The melt was 12% Si-Al alloy (JIS AC_3A) heated to 700°C, and was poured into the cavity formed by the outside perimeter and the lower mould, whereupon within 3 sec after pouring, pressure was applied using the top mould. The compressive load was 10 tons, and after applying pressure for 30 sec, the product was removed from the mould. After cooling, the surface condition of the product was observed in order to investigate the presence of sticking. This test was repeated ten times, and the number of times that sticking occurred was taken as a measure of moulding performance. Table 1 shows the results of performance evaluation for the compositions used in the comparative agent and the agents of the present invention described with reference to the examples of embodiment.

The following is clear from the table. Specifically, when agent **1** is compared with the comparative agent, it can be seen that mould release was dramatically improved with agent **1** due to the addition of solid lubricant. In addition, based on agents **1**, **2** and **3** of the present invention, it was found that a solid lubricant could be used with good effect, although it might not maintain its lubricating properties up to the melt temperature.

The minimum amount in which the solid lubricant is added to the agent of the present invention should be set to a level at which pronounced lubricating action is first noted between the particles of the main ingredient of the coating film, and the maximum amount should be determined based on the amount of primary ingredient required for sufficient coating of the inner surfaces of the mould. As a result of experimental calculation of the two limits, it was determined that the effective solid lubricant/main ingredient ratio is in the range of 2.3-0.1. In addition, the amount of binder must be 0.5-15% with respect to the sum of the amount of main ingredient and solid lubricant. If the added amount is below this range, then it will be impossible to form a coating film that maintains sufficient mechanical strength. If the amount is above this range, the viscosity of the liquid during production of the agent will be too

high, and a long period of time will be required for uniform dispersion of the main ingredient and the solid lubricant.

One or more types of solid lubricant may be used in the present invention, as presented in the examples of embodiment. Sufficient mould separation performance is achieved if the sum of the quantities thereof is within the above range. In addition, possible examples are not restricted to the aforementioned white materials, and black solid lubricants such as lead and molybdenum dinitride may also be added, provided that the amounts thereof are within a range in which the external appearance of the product is not compromised. It is possible to improve mould release performance by adding water-soluble silicone oil or emulsified wax or silicone to the agent. The reason for this is that these materials fill the cavities in the coating film, and are gasified and formed into a thermal insulation layer during pouring, so that the thermal insulation properties and plasticity of the coating film are improved. The addition of these substances thus improves mould release properties. Productivity can be improved if the mould release agent is diluted with water to produce a concentration appropriate for the application method. In addition, there are cases in which it is desirable to add small quantities of

surfactants and rust preventatives as necessary, and the addition thereof will not alter the effects of the present invention.

The mould release agents are suitable for use not only in melt casting as described above, but also as Al alloy mould release agents in die casting, vacuum casting or compression-free systems in which there is no load placed on the mould release agent.

Table I

Mould release agent		Present invention			Comparative agent	Conventional agent
		1	2	3		
Composition (%)	Main ingredient (mica)	10	7.5	7.5	15	15 (graphite)
	Solid lubricant	BN 5	CF 7.5	MCA 7.5	None	
	Binder (CMC)	1	1	1.5	1.5	1
	Water	Remainder	Remainder	Remainder	Remainder	Remainder
Mould release performance		0	0	0	6	0
External appearance of product		Good	Good	Good	Good	Discoloration